

CLAIMS

1. In a method for making a rigid polyurethane foam by reacting a polyisocyanate and a polyol in the presence of a urethane catalyst, a blowing agent, optionally water, and a silicone surfactant, the improvement which comprises employing a blowing agent comprising a C4 or C5 hydrocarbon, or mixtures thereof, with an average molecular weight of \leq 72 g/mole and a boiling point in the range of 27.8 to 50 °C, and a silicone surfactant comprising a polyether-polysiloxane copolymer represented by the following formula:



where

R= $(CH_2)_3-O-(-CH_2-CH_2-O)_a-(CH_2-CH(CH_3)-O)_b-R''$, and

15 where R'' is H, $(CH_2)_zCH_3$, or C(O)CH₃; x + y + 2 is 60-130; x/y is 5 - 14; z is 0-4; the total surfactant molecular weight, based on the formula, is 7000 - 30,000 g/mole, the wt% siloxane in the surfactant is 32 - 70 wt%, the blend average molecular weight (BAMW) of the polyether portion is 450 - 1000 g/mole, and the mole% of ethylene oxide in the polyether portion is 70 - 100 mole%.

20 2. The method of Claim 1 in which x + y + 2 is 60-130; x/y is 5-10; a + b is 10-18; and the mole% of ethylene oxide in the polyether portion is 70-100 mole%.

25 3. The method of Claim 1 in which x + y + 2 is 90-130; x/y is 10-14; a + b is 10-16; and the mole% of ethylene oxide in the polyether portion is 70-80 mole%.

4. The method of Claim 1 in which x + y + 2 is 60-80; x/y is 5-8; a + b is 10-16; and the mole% of ethylene oxide in the polyether portion is 70-100 mole%.

30 5. The method of Claim 1 in which x + y + 2 is 110-130; x/y is 5-8; a + b is 12-16; and the mole% of ethylene oxide in the polyether portion is 70-80 mole%.

6. The method of Claim 1 in which the blowing agent comprises cyclopentane, isopentane, isobutane or mixtures thereof.

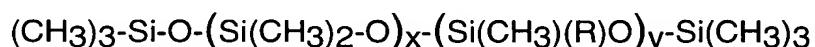
7. The method of Claim 1 in which the blowing agent comprises a mixture ranging from <100 to 50 wt% cyclopentane and >0 to 50 wt% isopentane, based on C5 components, and optionally also containing butane isomers.

5 8. The method of Claim 1 in which the blowing agent also contains a C1-C4 HFC or HCFC with a molecular weight of 50 to 170 g/mole and a boiling point of -60° to +50°C.

10 9. The method of Claim 1 in which the blowing agent also contains HFC-134a, HFC-236ea, HFC-365mfc, HCFC-22 or HFC-245fa.

10 10. The method of Claim 1 in which the blowing agent also comprises water at up to 4 pphp.

15 11. In a method for making a rigid polyurethane foam by reacting a polyisocyanate and a polyol in the presence of a urethane catalyst, a blowing agent, optionally water, and a silicone surfactant, the improvement which comprises employing a blowing agent comprising a C4 or C5 hydrocarbon, or mixtures thereof, with an average molecular weight of ≤ 72 g/mole and a boiling point in the range of 27.8 to 50
20 °C, and 0.5 to 3.5 pphp silicone surfactant comprising a polyether-polysiloxane copolymer represented by the following formula:



where

25 R= $(\text{CH}_2)_3\text{-O-}(-\text{CH}_2\text{-CH}_2\text{-O})_a\text{-}(\text{CH}_2\text{-CH}(\text{CH}_3)\text{-O})_b\text{-R''}$, and

where R'' is H or CH₃; x + y +2 is 110-130; x/y is 5-8; the total surfactant molecular weight, based on the formula, is 15,000-28,000 g/mole, the wt% siloxane in the surfactant is 34-53 wt%, the blend average molecular weight (BAMW) of the polyether portion is 550-850 g/mole, and the mole% of ethylene oxide in the polyether portion is 70-100 mole%.

12. The method of Claim 11 in which the blowing agent comprises cyclopentane, isopentane, isobutane or mixtures thereof.

13. The method of Claim 11 in which the blowing agent comprises a mixture ranging from <100 to 50 wt% cyclopentane and >0 to 50 wt% isopentane, based on C5 components, and optionally also containing butane isomers.

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14. The method of Claim 11 in which the blowing agent also contains a C1-C4 HFC or HCFC with a molecular weight of 50 to 170 g/mole and a boiling point of -60° to +50°C.

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15. The method of Claim 11 in which the blowing agent also contains HFC-134a, HFC-236ea, HFC-365mfc, HCFC-22 or HFC-245fa.

16. The method of Claim 11 in which the blowing agent also comprises water at up to 4 pphp.

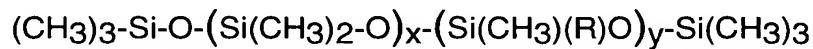
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17. A rigid polyurethane foam composition comprising the following components in parts by weight (pbw):

	<u>Rigid Foam Formulation</u>	<u>pbw</u>
20	Polyol	100
	Silicone Surfactant	1-3
	Blowing Agent	10-20
	Water	0-3
	Catalyst	0.5-3
25	Isocyanate Index	80-400

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where the blowing agent comprises a C4 or C5 hydrocarbon, or mixtures thereof, with an average molecular weight of ≤ 72 g/mole and a boiling point in the range of 27.8 to 50 °C (82 to 121°F), and the silicone surfactant comprises a polyether-polysiloxane copolymer represented by the following formula:



where

R= $(CH_2)_3-O-(-CH_2-CH_2-O)_a-(CH_2-CH(CH_3)-O)_b-R''$, and

where R" is H, $(CH_2)_zCH_3$, or $C(O)CH_3$; x + y +2 is 60-130; x/y is 5 - 14; z is 0-4; the total surfactant molecular weight, based on the formula, is 7000 - 30,000 g/mole, the wt% siloxane in the surfactant is 32 - 70 wt%, the blend average molecular weight (BAMW) of the polyether portion is 450 - 1000 g/mole, and the mole% of ethylene oxide in the polyether portion is 70 - 100 mole%.

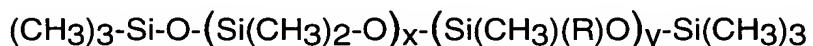
18. The composition of Claim 17 in which the blowing agent comprises cyclopentane, isopentane, isobutane or mixtures thereof.

19. The composition of Claim 17 in which the blowing agent comprises a mixture ranging from <100 to 50 wt% cyclopentane and >0 to 50 wt% isopentane, based on C5 components, and optionally also containing butane isomers.

15 20. The composition of Claim 17 in which the blowing agent also contains a C1-C4 HFC or HCFC with a molecular weight of 50 to 170 g/mole and a boiling point of -60° to +50°C.

20 21. The composition of Claim 17 in which the blowing agent also contains HFC-134a, HFC-236ea, HFC-365mfc, HCFC-22 or HFC-245fa.

25 22. The composition of Claim 17 in which the blowing agent comprises a mixture ranging from <100 to 50 wt% cyclopentane and >0 to 50 wt% isopentane, based on C5 components, and optionally also containing butane isomers, and the silicone surfactant is a polyether-polysiloxane copolymer represented by the following formula:



where

30 R= $(CH_2)_3-O-(-CH_2-CH_2-O)_a-(CH_2-CH(CH_3)-O)_b-R''$, and

where R" is H or CH_3 ; x + y +2 is 110-130; x/y is 5-8; the total surfactant molecular weight, based on the formula, is 15,000-28,000 g/mole, the wt% siloxane in the surfactant is 34-53 wt%, the blend average molecular weight (BAMW) of the polyether

portion is 550-850 g/mole, and the mole% of ethylene oxide in the polyether portion is 70-100 mole%.